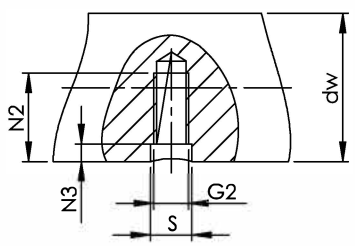
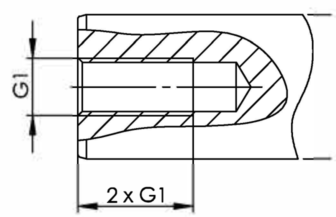
Standard Axial and Radial Threads

If precision shaft are to be combined with shaft support, radial holes are needed. Radial holes are drilled in the precision shaft after hardening and grinding. Thread size and depth depend on the diameter of the shaft.



Radial thread (RT)



Axial thread (AT)

Radial Thread

Type	G_2	S	N_3	N_2 (min)
RT W12 - W15	M4	5	2	7
RT W16 - W20	M5	6	2,5	9
RT W20 - W25	M6	7	3	11
RT W25 - W30	M8	9	3	15
RT W30 - W40	M10	11	4	19
RT W40 - W50	M12	13	4	21
RT W50 - W60	M14	15	4	25

Axial Thread

Type	G_1	2 x G_1
AT W8 - W10	M3	6
AT W10 - W12	M4	8
AT W12 - W14	M5	10
AT W14 - W20	M6	12
AT W15 - W25	M8	16
AT W18 - W40	M10	20
AT W24 - W50	M12	24
AT W30 - W80	M16	32
AT W50 - W80	M20	40
AT W60 - W80	M24	48

Dimensions in mm.

Separating cut

The precision shaft is cut to length and the faces are deburred using a manual chamfer. No other processing is done. The separating cut is standard.

Straightness

The standard straightness depent on shaft diameter.

Straightness measurement per ISO 13012.

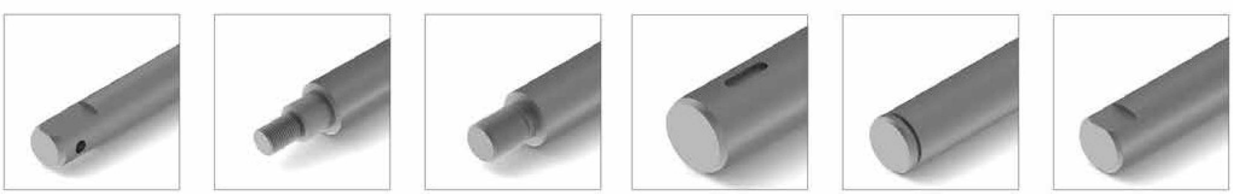
Dimeter dw	Straightness t3
dw ≤ 4	0,3
5 < dw ≤ 8	0,2
10 ≤ dw	0,1

Dimensions in mm.

Special processing

If necessary, special processing can be carried out according to the needs of the customer. A great variety of shapes and combinations is possible. A few processing options are listed below.

- Journal
- Feather key groove
- Flattening or flutes
- Clearance groove
- Crosswise groove
- Axial / radial threads (metric / imperial)
- External threads (metric / imperial)

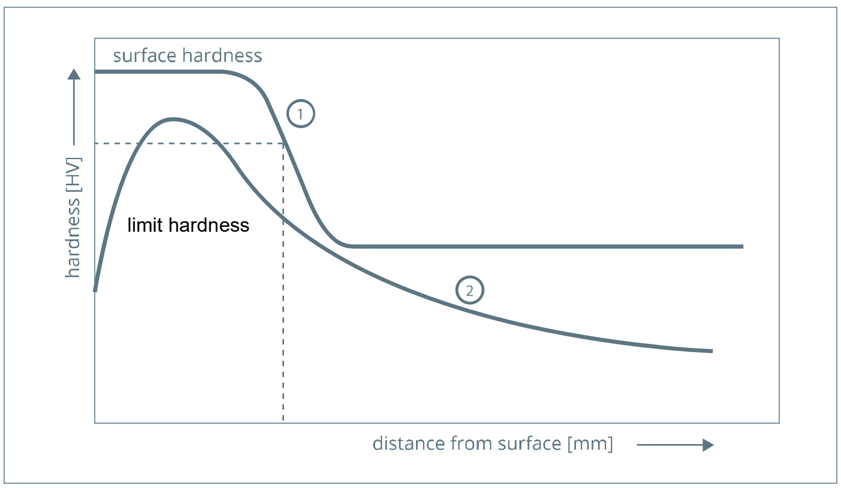


Special processing

Surface hardening depth

For rolling bearings like linear ball bearings to work reliably with precision steel shafts, the Hertzian contact stress must be considered during design of the surface hardening depth (SHD):

- The surface hardening depth is the depth of the hardened zone in which 80% of the surface hardness is present as a limit hardness.
- Under the surface of a track with a ball carrying force Qc, there is a three-axis stress.
- The maximum stress occurs at a certain distance from the surface of the trac.
- The hardness characteristic (1) must run into the core area of the material in such a way that the rigidity derived from the hardness is higher than the comparison stress curve (2) of the three-axis stress at all points.
- For other special processing contact Rollco.



Shaft Ø dw	Surface hardening depth (SHD)
dw ≤ 10	0,4 min. (fully hardened possible)
10 < dw ≤ 18	0,6 min.
18 < dw ≤ 30	0,9 min.
30 < dw ≤ 50	1,5 min.
50 < dw ≤ 80	2,2 min.
80 < dw ≤ 100	3,2 min.

Dimensions in mm.

Lower track hardness

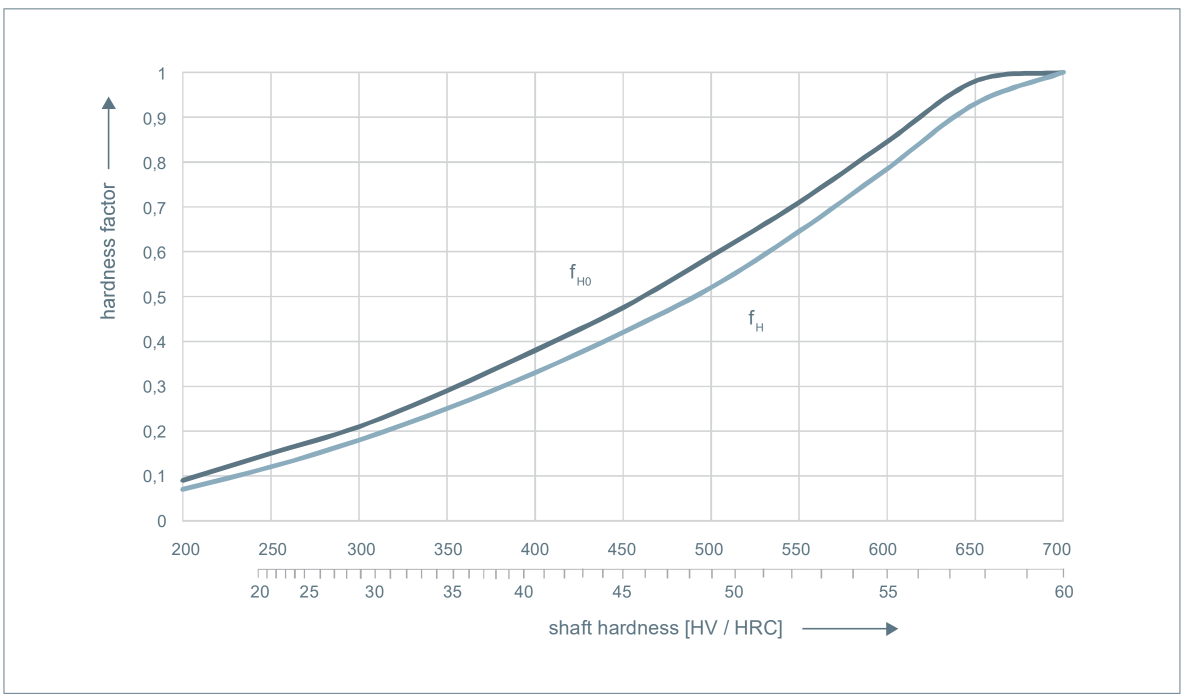
If corrosion-resistant precision shafts stated below are used for a rolling bearing, the dynamic and static load ratings C and C_o are reduced due to the lower track hardness of the shafts.

- X46 Cr13 / 1.4034
- X90 CrMoV18 / 1.4112

$$C_H = f_H \cdot C$$

$$C_{OH} = f_{HO} \cdot C_o$$

CoH, CH [N]
effective static and dynamic load with lower hardness
fH0, fH [-]
static and dynamic hardness factor
C0, C [N]
static and dynamic load of linear bearing



Static and dynamic hardness factors for lower hardness of shaft

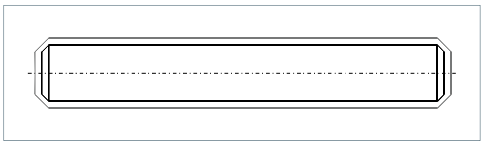
Note

- Surface hardening only limits the corrosion resistance of X46 and X90 precision shafts on the faces.
- To avoid deposits of more base metals on the surface of corrosion-resistance precision shafts, machining should be carried out using solid carbide or ceramic tools. This allows surface corrosion (rust bloom) to be avoided.

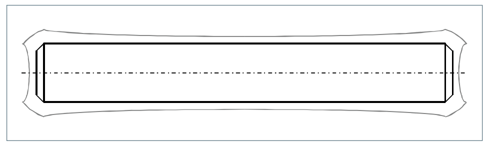
Chrome plated coating

The chrome layer is galvanically applied to precision shafts at a temperature between 50 °C and 60 °C, do that no structuralchanges occur.
The chrome plating process takes place as a continuous process in a chrome plating system. This has the following advantages over conventional frame chrome plating:

- The continuous process provides an even coating of chrome, without flow density dependent differences in coating thickness (“bone effect”).
- Chrome coating over the entire length of the shaft without uncoated areas or contact points for up to 6 meters.
- High processing capability.
- Environmentally friendly, since the continuous chrome plating system is a closed system.



Continuous process



Conventional process

Properties of the coating

- High wear resistance.
- In roller bearing applications, prevention of formation of false brinelling under vibration while stationary.
- Low coefficient of friction.
- Additional wear protection for roller bearings subject to mixed friction.
- Anti-stick effect due to low adhesion effect.
- Good corrosion resistance to outer diamter.

Application

Since chrome layer does not contain Cr(VI), this coating is suitable for use in the food industry, medical technology, etc.

Product id	Layer thickness	Layer hardness	Number of layer	Corrosion protection	Wear protection	Max. single length	Cr(VI) free
WV	ca. 10 µm	800HV - 1100HV	1	Good, can be improved by belt polishing	Mixed friction	L > 6000 mm upon request	Yes

Contact factor (f_C)

Load biasing, attributed to mounting errors and multiple bearing assemblies can be accounted for by using the coefficient in table.

Number of bearings for shaft	Contact factor
1	1.00
2	0,81
3	0,72
4	0,66
5	0,61

Load factor (f_W)

The loads acting on the linear units include payload, inertial effects during acceleration and deceleration as well as moment loads. All of these factors are difficult to assess and are further complicated by the potential presence of shocks and vibrations. A more practical solution involves the use of the coefficients in table.

Operating conditions	f_W
Low speed operations (< 15 m/min) without shockloads	1 - 1,5
Medium speed operations (60 m/min) without shockloads	1,5 - 2
High speed operations (> 60 m/min) without shockloads	2 - 3,5

Static safety factor

For applications with a high requirement for accuracy and smooth running, the static safety factor fs should be higher than the values shown in table to prevent permanent deformation at the contact points.

$$f_S = \frac{C_o}{Po}$$

f_S = static safety factor
Po = static equivalent load (N)
C_o = static load rating (N)

Operating conditions	f_S
Shafts subjected to small deflections and low shocks	1 ÷ 2
Elastic deflection can cross load the units	2 ÷ 4
System subjected to shock & vibration	3 ÷ 5

Mounting tolerances

The table below shows the tolerances to be used for a proper bearing installation. They insure a precise and smooth motion.

Recommended mounting tolerances for SBE-LME-LMES-KH bushings

Housing material	Housing tolerance
Steel/cast iron	H7
Aluminium/alloy	H7

Friction

The magnitude of the friction force is affected by several factors. The type of bearing, the operating conditions, the type and quantity of the lubricant, the presence or lack of seals all impact the overall frictional behaviour.

Standard seals can add between 2 and 5 N to the overall friction force.

The magnitude of the coefficient of friction depends upon the operating conditions such as load, moments and/or preload. Table below shows the dynamic coefficient of friction for each type of bearing under normal operating condition (P/C = 0.2) and proper assembly.

Type of bearing	Friction coefficient
KH	0.004 to 0.006
LME/SBE	0.002 to 0.003

Operating temperature

The operating temperature ranges of the various bearings are shown in table below. Should the operating temperature exceed the limits shown in the table, please contact Rollco. Stainless steel units, without seals, can operate between -20/+120°C.

Type of bearing	Operating temperature
KH	-20 to + 100°C
LME/LMES/SBE	-20 to + 100°C

Lifetime calculation

Dynamic load rating C

The dynamic load rating C is a load of constant magnitude under which 90% of a statistically significant number of apparently identical bearings would reach a theoretical life of 50 km without the apparent appearance of metal fatigue.

Static load rating C_0

The static load rating C_0 is defined as the load that would cause a permanent deformation equal to 1/10.000 of the ball diameter at the most stressed contact point.

Life of a linear ball bearing

Repeated stresses onto the contact surfaces could lead to material fatigue, this will lead to the appearance of surface pitting. The life of the unit is defined as the duration before the appearance of pitting.

Rated life (L)

The rated life L is the total traveled distance which 90% of a statistically significant number of apparently identical bearings would reach under the same operating conditions without the apparent appearance of metal fatigue.

$$L = (C/P)^3 \cdot 50 \quad (1)$$

L = rated life (km)
C = dynamic load ratings (N)
P = equivalent dynamic load (N)

When a system is subjected to a load equal to the dynamic load rating C the resulting life equal the rated life (50 km). The theoretical life of a linear bearing is affected by the load and by the operating conditions (temperature, vibration, shock, load distribution, etc.) In such cases the theoretical life is calculated with the help of equation 2.

$$L = (f_c \cdot C / f_w \cdot P)^3 \cdot 50 \quad (2)$$

L = rated life (km)
C = dynamic load ratings (N)
P = equivalent dynamic load (N)
f_c = Contact coefficient
f_w = Load factor

The following equation (3) allows the conversion of the rated life in hours.

$$L_h = L \cdot 10^3 / (2 \cdot Ls \cdot n_1 \cdot 60) \quad (3)$$

L_h = rated life (hours)
Ls = stroke length (m)
L = rated life (km)
n_1 = operating frequency (stroke/min)